

学校编码: 10384

分类号\_\_\_\_\_密级\_\_\_\_\_

学号: 15420111151894

UDC\_\_\_\_\_

厦 门 大 学

硕 士 学 位 论 文

# 基于参数拟合模型的交易所与银行间市场 国债利率风险比较研究

Study on Treasury's Interest Rate Risk between Exchange  
and Interbank Bond Markets based on Parametric Model

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论文提交日期: 2014 年 3 月

论文答辩时间: 2014 年 5 月

学位授予日期: 2014 年 6 月

答辩委员会主席: \_\_\_\_\_

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2014 年 3 月

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## 摘 要

随着我国利率市场化进程的逐步推进,市场资金的供求关系逐渐成为影响利率的主要因素,而利率的波动也更加的频繁。如何对利率期限结构进行建模,并从中提取出利率波动的风险因素变得越来越重要。由于交易机制、参与主体上的差异,交易所与银行间债券市场形成两个分割的主体。本文基于利率期限结构理论,以交易所与银行间国债市场作为研究对象,运用参数拟合模型分别拟合两个市场的利率期限结构。根据估计得到的即期利率时间序列数据,运用主成分分析(PCA)方法提取利率波动的风险因素,解释各个因子所代表的涵义,并与美国国债市场进行对比,进而提出构建统一、高效的债券市场的对策。

按照上述研究思路,本文所做的工作主要包括以下几个方面:

第一,选取2012年1月6日至2013年12月3日上海证券交易所与银行间债券市场的国债原始数据进行实证分析,基于Nelson-Siegel(NS)模型和Svensson(SV)模型分别拟合了交易所与银行间国债市场即期利率的利率期限结构,通过理论分析和实证对比,发现SV模型更适合用来拟合我国国债利率期限结构。

第二,基于SV模型得到的即期利率,通过主成分分析方法提取交易所国债市场与银行间国债市场各自的利率波动风险因素,对比分析两个市场利率波动的风险性因素,并与美国国债市场进行对比。通过对比研究,发现三因子利率动态模型基本上能够刻画美国国债市场的收益率变动,即水平因素(level)、倾斜因素(slope)和曲度因素(curvature);而中国市场(主要是交易所与银行间市场)需要四个因子才能较好地涵盖国债收益率变动的风险。其中,交易所与银行间市场第四个因子的方差贡献率分别达到了2.9849%和2.3868%,说明利率风险中未被解释的部分比重仍比较大。从市场分割的角度出发,作者认为交易机制、信息反应速度、债券发行规模、风险对冲机制是造成第四个因子比重较大的原因。

第三,本文实证发现,相较于唐革榕和朱峰(2003)<sup>[1]</sup>的研究结果,交易所与银行间市场的国债利率期限结构对三因子模型的解释能力都提高了很多,而且两个市场之间的差距也在不断缩小。相比之下,银行间债券市场的利率波动分解出的倾斜因素和曲度因素解释总方差变动的比率与美国债券市场的情况比较接近,这可能与银行间市场的交易机制、参与主体跟国外市场比较相似有关。

**关键词:** 交易所; 银行间市场; 参数拟合模型; 利率风险; PCA

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## Abstract

With China's interest rate market to promote the supply and demand of funds in financial markets are becoming the most important factor in the changes in interest rates. Due to changes in interest rates more frequently, how to model the term structure of interest rates, and extract the risk factors of interest rate volatility become more and more important. Due to the differences on trading mechanism and the main body of investment, exchange bond market and inter-bank bond market formed two separate subjects. This article reviews the term structure of interest rates theory, using bond data of exchange and inter-bank market, fitting the term structure of interest rates on the two markets based on Nelson-Siegel (NS) model and Svensson (SV) model. Based on the estimated time series data of spot interest rates, the author used principal component analysis (PCA) method to extract risk factors of interest rate volatility, explained the meaning of each factor and compared them with U.S. treasury market. Then discuss the directions to consummate our bond market.

Based on the above ideas, this paper includes three conclusions.

First of all, the article select the original bond data of Shanghai stock exchange bond market and inter-bank bond market on January 6, 2012 to December 3, 2013. Then fit the term structure of interest rates on the two markets based on NS model and SV model. Through theoretical analysis and empirical comparison, the author found that SV model is more suited to fit the treasury's term structure of interest rates.

In addition, based on the estimated time series data of spot interest rates according to SV model, the author used principal component analysis (PCA) method to extract risk factors of interest rate volatility, explained the meaning of each factor and compared them with U.S. treasury market. According to the previous theoretical study, the vast majority of risk factors of interest rate volatility can be explained by the level factor, the slope factor and the curvature factor. We have found that the bond interest rate risk of exchange and inter-bank markets need to be covered by four factors. The variance contribution rate of the fourth factor of the exchange and



inter-bank market has reached 2.9849% and 2.3868%, indicating that the unexplained part of the interest rate risk is still a large proportion. From the point of market segmentation, the author believed that the trading mechanism, the reaction rate, bond issuance and risk hedging mechanism contribute a lot to that.

Furthermore, we have found that compared to the findings of Tang Ge Rong, Zhu Feng (2003) the three-factor model of the two markets has improved a lot and the gap between them has narrowed a lot. In contrast, the slope factor and the curvature factor decomposed from the interest rate volatility of inter-bank market explain the similar changes with the U.S. treasury market in the ratio of the total variance. It may be related to that inter-bank market's trading mechanism and the main body of the investment are quite similar with the foreign markets.

**Keyword:** Exchange; Inter-bank market; Parametric model; Interest rate risk; PCA

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